THE THERMAL SPRINGS OF SELANGOR AND MALACCA.

BY

DR. W. BOTT, F.C.S., F.G.C.S., &c.

THE following account represents a brief summary of the results of two official visits to Selangor and Malacca undertaken in August and November, 1890, respectively. Many of the results have already appeared in the report published by Government. A great many details—such as description of apparatus employed, methods of collecting gases, and analytical methods used, which really form the most valuable part of the paper from a strictly scientific point of view—have been omitted, as being obviously not suitable for publication in this Journal; these will be found in the complete paper which will shortly be published in England and Germany (Proc. Royal Soc. and Berlin Chem. Soc.). In reference to the analytical data given, I wish to point out, that these only represent the approximate composition of the water of the springs, owing to unavoidable admixture of ordinary surface water in most cases. I hope at a future date to be able to visit these springs again, provided with such apparatus and appliances as will enable me to collect the water absolutely free from foreign admixtures. The numbers given, however, if not absolutely true, will, I believe, be found to require but a trifling correction in each case.

General Nature of the Springs.

All the springs visited by me and described more fully later on, belong to the class of "Simple Thermal Waters," viz., they are characterised by a high temperature, but do not contain any considerable amount of dissolved mineral matter. This circumstance, and the small amount of lime in the water, seems to indicate that all these springs rise from silicious and not from calcareous tracts, although no strictly reliable relation can ordinarily be established in such cases between the chemical nature of a spring and its ultimate source. The immediate and obvious surroundings of the springs are old granitic formations. This also applies to those springs which are situated in padi swamps, and where granite, though not apparent, is found below the mud surface. In addition to common and porphyritic granite, quartz, as rock and pebbles, diorite, gneiss and greissen (a kind of granite practically free from felspar which often forms the matrix of tin lodes) are found, but limestone is not apparent. The latter remark, however, does not apply to the springs of Ulu Selangor, which I was unable to visit in person.

The springs themselves appear as pools or puddles of hot water, varying in area from 1 to 3 or more square yards, and generally fed by two or more distinct streams or jets issuing from holes and crevices in the bottom of the basin. Bubbles of gas are observed continually to emerge with these jets and ascend through the supernatant hot water. These consist essentially of nitrogen and carbon dioxide with a small quantity of hydrogen sulphide and traces of hydrogen and marsh gas. The presence of hydrogen sulphide is apparent from the sulphurous smell in the vicinity of the springs and the water itself owes to this gas a slight smell and taste. The beds of the springs consist of granitic rock more or less decomposed on the surface and coated with silicious sinter. The floor of these beds is covered with all kinds of loose vegetable and mineral debris in the form of granular sediment or soft fibrous and gelatinous masses. The latter accumulate in parts and often form a thick continuous layer on the surface of the water having a green and in some cases a bright orange red colour. The consistency and general appearance of this substance varies from a loose, fibrous structure resembling soft, dense moss, to a gelatinous, homogeneous texture not unlike India-rubber. A careful microscopical examination of these masses showed that they consist of decayed organic matter derived from leaves and other vegetable substances which find their way into the water and undergo decomposition at a comparatively high temperature. They represent a dense magma of cells of most variable shape and appearance, reprensentative of almost every kind of vegetable cell in existence. How far this growth may be looked upon as a whole, as an individual, as a living thing increasing actively, or a dead product growing passively by mechanical addition,—these are questions of considerable interest, to be settled by a separate investigation, and I hope to discuss this subject fully in a future paper. In several specimens of the vegetable matter from Ulu Klang and Setapak, a distinct form of algæ was found, and I have since been informed, that similar specimens had been found in Ayer Panas water, Malacca, and sent to the British Museum for examination. It appears, however, that this has led to no further results. The temperature of the springs ranges from about 100° to 185° F. in Selangor, and 95° to 130° F. in Malacca. It varies moreover in each spring according to the distance from the feeders, being highest at the point where they enter.

A number of complete analyses were made of the air in the vicinity of the springs. The air was found to be of normal composition though free from active oxygen or ozone. Air collected close to the springs was found to contain traces of hydrogen sulphide and rather more than the normal amount of carbonic acid and ammonia. The details of these analyses will be given subsequently.

All the springs contain a considerable amount of dissolved silica. On keeping samples of the water part of this is deposited in a pulverulent state, sometimes, however, very thin, soft, transparent, glistening films separate from the water and these on analysis are found to consist of silica, organic matter and traces of sulphur.

SPRINGS IN SELANGOR.

SETAPAK SPRING.

Temperature, ...	47-50° Centigrade (118-122° Fahrenheit).
Total solids dissolved in water,	18.35 grains per gallon.
Chlorine, ...	0.4 ,, ,,
Hardness, ...	3.6 ,, ,,
Free Ammonia, ...	0.036 parts per million.
Albuminoid Ammonia, ...	0.10 ,, ,, ,,

The quantity of dissolved constituents amounts to 3.10108 parts in 10,000 of the water, viz. :—

Calcium Carbonate, ...	... 0.23	parts in	10,000.
Calcium Sulphate, ...	... 0.25	,,	,,
Magnesium ,, ...	... 0.014	,,	,,
Sodium ,, ...	... 0.21	,,	,,
Potassium ,, ...	... 0.08	,,	,,
Sodium Carbonate, ...	... 0.43	,,	,,
Ammonium ,, ...	... 0.00108	,,	,,
Sodium Chloride, ...	... 0.043	,,	,,
Potassium ,, ...	... 0.005	,,	,,
Lithium ,, ...	... trace	,,	,,
Sodium Sulphide, ...	... 0.025	,,	,,
Boric Acid, ...	... trace	,,	,,
Carbonic Acid, ...	... 0.71	,,	,,
Nitrogen, ...	... 0.09	,,	,,
Hydrogen Sulphide, ...	... 0.034	,,	,,
Organic Matter, ...	... 0.120	,,	,,
Silica, ...	... 0.859	,,	,,
	3.10108	,,	,,

The gases escaping from the spring were collected and analysed, giving the following percentage composition :—

Nitrogen, ...	97 %.
Carbonic Acid, ...	... 2.5%.
Hydrogen Sulphide,	... 0.5%.
Hydrogen, ...	... trace.
Marsh Gas, ...	... ,,
Total,	... 100.00.

A number of analyses were also made of samples of air collected close to the spring, and the following mean results were obtained :—

Oxygen,	... 20.885%	by volume.	
Nitrogen,	... 79.115	,,	,,
Carbonic Acid,	... 0.06	,,	,,
	100.060		

The ammonia was determined separately and amounted to 0.055 parts by weight in 1,000 of air. The air near the spring differs consequently from ordinary air slightly by containing a little more carbonic acid (0.06%, as against 0.03 to 0.04 in normal air).

GOMBAK SPRING.

Temperature, ... 50-54° Centigrade (122-129° Fahrenheit).
Total solids dissolved in the water, 21.333 grains per gallon.

Hardness,	3.6	,,	,,
Chlorine,	0.55	,,	,,
Free Ammonia,	0.04	parts per	million.
Albuminoid Ammonia,	0.05	,, ,,	,,

Total constituents dissolved in 10,000 parts of the water, 3.9942, viz. :—

Calcium Carbonate,	... 0.26	parts in	10,000.
Sodium ,,	... 0.22	,,	,,
Ammonium ,,	... 0.0012	,,	,,
Calcium Sulphate,	... 0.285	,,	,,
Magnesium ,,	... 0.016	,,	,,
Sodium ,,	... 0.199	,,	,,
Potassium ,,	... 0.093	,,	,,
Sodium Chloride,	... 0.065	,,	,,
Potassium ,,	... 0.012	,,	,,
Lithium ,,	...		
Sodium Sulphide,	... 0.018	,,	,,

Hydrogen Sulphide,	0.030	parts in 10,000.
Boric Acid,		
Carbonic Acid,	0.81	,, ,,
Nitrogen ,,	0.08	,, ,
Organic Matter,	0.09	,, ,,
Silica,	1.765	,, ,,
Total,	3.9942	,, ,,

Composition of Gases escaping from Spring.

Nitrogen,	98.1%	by volume
Carbonic Acid,	1.9%	,,
Hydrogen Sulphide,	0.3%	,,
	100.3	

Composition of Air close to Spring.

Oxygen,	20.90%	by volume.
Nitrogen,	79.10%	,,
Carbonic Acid,	0.06%	,,
	100.06%	

SEMUNIAH SPRING.

Temperature,	45-50°C. (113-122° F.).	
Hardness,	3.4	grains per gallon.
Chlorine,	0.5	,, ,,
Total solids dissolved in the water,	20.5	,, ,,
Free Ammonia,	0.04	parts per million.
Albuminoid Ammonia,	0.05	,, ,,

Constituents contained in 10,000 parts of the water :—

Calcium Carbonate,	0.21	parts in 10,000.
Sodium ,,	0.1900	,, ,,
Ammonium ,,	0.0015	,, ,,

Calcium Sulphate,	0.2800	parts in	10,000.
Sodium ,,	0.2010	,,	,,
Magnesium ,,	0.0190	,,	,,
Potassium ,,	0.0800	,,	,,
Sodium Chloride,	0.0700	,,	,,
Potassium ,,	0.0100	,,	,,
Lithium ,,	trace	,,	,,
Sodium Sulphide,	0.00900	,,	,,
Hydrogen ,,	0.0400	,,	,,
Boric Acid,	...		
Carbonic Acid,	0.7600	,,	,,
Nitrogen,	0.0900	,,	,,
Organic Matter,	0.1200	,,	,,
Silica,	1.4000	,,	,,
		,,	,,
Total,...	3.4805	,,	,,

Composition of Gases from Spring.

Nitrogen,	96.00%	by volume.
Carbonic Acid,	3.00	,,
Hydrogen Sulphide,	0.70	,,
Hydrogen Marsh Gas,	0.30	,,
	100.00	

Composition of Air close to Spring.

Oxygen,	20.85%	by volume.
Nitrogen,	79.08	,,
Carbonic Acid,	0.07	,,
	100.00	

Ammonia contained in air close to spring=0.12 in 1,000 parts by weight.

Dusun Tua Spring.

Temperature,	45-50° C. (122° F.).	
Total solids dissolved in water,	15.4	grains per gallon.
Hardness,	2.3	,, ,,
Chlorine,	0.25	,, ,,
Free Ammonia,	0.04	parts per million.
Albuminoid Ammonia,	0.03	,, ,,

Constituents contained in 10,000 parts of the water :—

Calcium Carbonate,	0.1357	parts in 10,000.
Sodium ,,	0.08000	,, ,,
Ammonium ,,	0.00053	,, ,,
Calcium Sulphate,	0.11400	,, ,,
Sodium ,,	0.09900	,, ,,
Magnesium ,,	0.01200	,, ,,
Potassium ,,	0.06300	,, ,,
Sodium Chloride,	0.05100	,, ,,
Potassium ,,	0.00400	,, ,,
Lithium ,,	trace	,, ,,
Sodium Sulphide,	0.00900	,, ,,
Hydrogen ,,	0.03200	,, ,,
Boric Acid,	trace	,, ,,
Carbonic ,,	0.92000	,, ,,
Nitrogen ,,	0.07000	,, ,,
Organic Matter,	0.04031	,, ,,
Silica,	0.61200	,, ,,
Total,	2.20141	,, ,,

Gases escaping from Spring.

Nitrogen,	96.5%	by volume.
Carbonic Acid,	2.9	,,
Hydrogen Sulphide,	0.4	,,
Hydrogen and Marsh Gas,	traces.	

Composition of Air close to Spring.

Nitrogen,	79.04
Oxygen,	20.91
Carbonic Acid,	0.05
Total,	100.00

ULU SELANGOR SPRING.

Temperature, ...	100.2% F. (38 C.).
Hardness, ...	3.5. grains per gallon.
Total solids dissolved in the water,	19.5 ,, ,,
Chlorine, ...	0.5 ,, ,,
Free Ammonia, ...	0.16 parts per million.
Albuminoid Ammonia, ...	0.12 ,, ,,

Constituents dissolved in 10,000 parts of the water:—

Calcium Carbonate, ...	0.2100	parts in 10,000
Sodium ,, ...	0.1800	,, ,,
Ammonium ,, ...	0.0025	,, ,,
Calcium Sulphate, ...	0.1900	,, ,,
Magnesium ,, ...	0.0180	,, ,,
Sodium ,, ...	0.1850	,, ,,
Potassium ,, ...	0.0600	,, ,,
Sodium Chloride, ...	0.0700	,, ,,
Potassium ,, ...	0.0090	,, ,,
Lithium ,, ...	trace	,, ,,
Potassium Iodide, ...	trace	,, ,,
Sodium Sulphide, ...	0.0090.	
Hydrogen* ,, ...	not determined.	
Boric Acid, ...	trace.	
Carbonic Acid,*	not determined.	
Nitrogen,*	,,	
Organic Matter, ...	0.1100	parts in 10,000
Silica, ...	1.2000	,, ,,
Total,...	1.2135	parts in 10,000

Composition of Gases from Ulu Selangor Spring and surrounding Air.

Not determined, as I did not visit the spring in person.

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* These constituents were not determined, as I did not personally visit this spring, and they can only be correctly estimated in freshly collected water. Judging by analogy they would differ but slightly from the amounts under "Gombah."

Ulu Klang Spring.

Temperature,	83-84° C. (181-183° F.).		
Hardness,	2.0	grains	per gallon.
Chlorine,	0.45	,,	,,
Free Ammonia,	0.03	parts	per million.
Albuminoid Ammonia,	0.04	,,	,,
Total solids dissolved in the water,	21.95	grains	per gallon.

Constituents dissolved in 10,000 parts of the water:—

Calcium Carbonate,	0.1600	parts	in 10,000
Sodium ,,	0.1950	,,	,,
Ammonium ,,	0.0050	,,	,,
Calcium Sulphate,	0.1250	,,	,,
Magnesium ,,	0.0201	,,	,,
Sodium ,,	0.2200	,,	,,
Potassium ,,	0.0955	,,	,,
Sodium Chloride,	0.0500	,,	,,
Potassium ,,	0.0150	,,	,,
Lithium ,,	trace	,,	,,
Sodium Sulphide,	0.0200	,,	,,
Hydrogen ,,	0.0350	,,	,,
Boric Acid,	...	,,	,,
Carbonic Acid,	0.8050	,,	,,
Nitrogen,	0.0700	,,	,,
Potassium Iodide,	trace	,,	,,
Organic Matter,	0.0950	,,	,,
Silica,	1.5000	,,	,,
Total,	3.4606	,,	,,

Composition of Gases escaping from Spring.

Nitrogen,	95.85
Carbonic Acid,	3.50
Hydrogen Sulphide,	0.65
Hydrogen and Marsh Gas,	trace
	100.00

Composition of Air close to Spring.

Oxygen,	20.870
Nitrogen,	79.060
Carbonic Acid,	0.070
Hydrogen Sulphide,	trace
	100.00

(Ozone or active Oxygen absent).

Ammonia in air near spring, 0.11 parts in 1,000 parts by weight.

A sample of air was collected about 1½ miles from the spring, and the ozone in it determined.

The mean result of the separate experiments was 0.000,0011 milligrams per litre of air.

Composition of Rocks from the Spring.

It has already been stated that the formations in the immediate vicinity of the springs are granitic, the principal component minerals being accordingly:—Quartz, Felspar, Mica (Muscovite and Zinwaldite) and Hornblende.

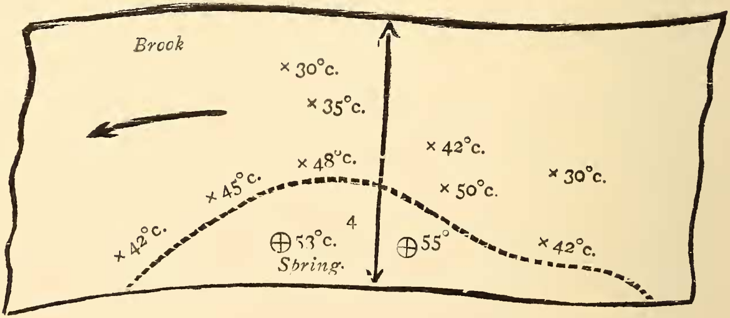
The average composition of the rock (from 6 analysis) is shown below:—

Silica,	74.30%
Alumina,	14.20 ,,
Alkalis,	5.10 ,,
Lime,	3.00 ,,
Magnesia,	0.60 ,,
Iron (taken as Ferric Oxide),	1.10 ,,
Moisture, Oganic Matter, Manganese, &c.,	1.70 ,,
	100.00%

Tin ore in varying though small quantities is found disseminated through the mass of some of the specimens. Gold was absent in all the samples I took, with the exception of a piece of Diorite found at Ulu Klang, which contained a quantity corresponding to ¾ oz. to the ton. I do not for the present attach any importance to this circumstance, as it may be a purely sporadic occurrence; yet it might be worth while to obtain a proper sample taken from a large quantity of the rock near Ulu Klang and have it tested for gold. I am not aware whether or not gold has ever been found or been supposee to exist at Ulu Klang.

SPRINGS IN MALACCA.

The springs found in Malacca in all respects closely resemble the Selangor Springs (*see* under General Nature of the Springs). One spring at Cherana Puteh is situated in the jungle, those at Ayer Panas and Alor Gajah occur in padi swamps. The latter two have been properly set for bathing purpose, so I can say nothing about their original condition and appearance. The spring at Cherana Puteh appears as a pool or puddle of hot water in a bed of dark grey mud from which bubbles of gas are continually ascending. At the time of my visit a little brook was flowing close to the spring and mixing with it to a certain extent. No line of demarcation between the brook and the water from the spring was visible, but could be readily detected with a thermometer; the differences observed are worthy of note (*see* sketch below).



It will be noticed that within small distances of a foot or even 6 inches the temperature varies very considerably. The points marked × indicate places where the temperature was taken, those marked ⊕ mark the entrance of feeders or "eyes" of the spring, and naturally possess the highest temperature.

Spring at Ayer Panas.

The temperature of this water varies considerably in the different tanks or wells in which the spring has been collected.

a.—Tanks inside house.
No. 1 = 45° Centigrade (113° Fahrenheit).
,, 2 = 35° ,, (95° ,,).
,, 3 = 45° ,, (113° ,,).
,, 4 = 52° ,, (123° ,,).

b.—Tank outside house on ground immediately adjoining.
No. 5 = 55° Centigrade (131° Fahrenheit).

c.—Tank in padi swamp behind house.
No. 6 = 52° Centigrade (125° Fahrenheit).

d.—Tanks in front of house in the field.
(Left) No. 7 = 33° Centigrade (91° Fahrenheit).
(Right) No. 8 = 48° ,, (118° ,,).

Analysis of water taken from hottest tank, No. 5 :—

Total solids dissolved in the water,	18.40	grains	per gallon.
Hardness, ...	2.5	,,	,,
Chlorine, ...	0.7	,,	,,
Free Ammonia, ...	0.05	parts	per million.
Albuminoid Ammonia, ...	0.05	,,	,,

Constituents dissolved in 10,000 parts of the water :—

Calcium Carbonate, ...	0.160	parts	in 10,000
Calcium Sulphate, ...	0.180	,,	,,
Magnesium ,, ...	0.015	,,	,,
Sodium ,, ...	0.190	,,	,,
Potassium ,, ...	0.085	,,	,,
Sodium Carbonate, ...	0.450	,,	,,
Ammonium ,, ...	0.00018	,,	,,

Sodium Chloride	0.095	parts in 10,000
Potassium ,,	0.006	,, ,,
Sodium Sulphide,	0.020	,, ,,
Hydrogen ,,	0.025	,, ,,
Carbonic Acid,	0.585	,, ,,
Nitrogen,	0.085	,, ,,
Silica,	0.780	,, ,,
Organic Matter,	0.250	,, ,,
Total,	2.92618	,, ,,

Spring near Alor Gajah.

Part of this spring has been collected in a tank inside a little house, part of it rises in the bed of a little brook close to this house, and a third outlet has been set and received in a square bricked trough or well. The latter evidently (from its temperature, etc.) corresponds to the main feeder.

Temperature of water inside house,	35° C.	(95° F.).
Temperature of water in the brook,	40° ,,	(104° F.).
Temperature of water in bricked well,	55° ,,	(131° F.).
Hardness,	2.5	
Total solids dissolved in the water,	1.7	grains per gallon.
Chlorine,	0.5	,, ,,
Free Ammonia,	0.04	parts per million.
Albuminoid Ammonia,	0.05	,, ,,

Constituents contained in 10,000 parts of the water:—

Calcium Carbonate,	0.200	parts in 10,000.
Calcium Sulphate,	0.140	,, ,,
Magnesium ,,	0.025	,, ,,
Sodium ,,	0.150	,, ,,
Potassium ,,	0.095	,, ,,
Sodium Carbonate,	0.550	,, ,,
Ammonium ,,	0.00015	,, ,,
Sodium Chloride,	0.075	,, ,,
Potassium ,,	0.005	,, ,,
Lithium ,,	trace	,, ,,

Sodium Sulphide,	0.019	parts in	10,000.
Hydrogen ,,	0.020	,,	,,
Carbonic Acid,	0.480	,,	,,
Nitrogen,	0.075	,,	,,
Silica,	0.590	,,	,,
Organic Matter,	0.295	,,	,,
	2.71915	,,	,,

SPRING AT CHERANA PUTEH.

Situated in a piece of jungle with bed of soft mud mixed with particles of quartz and granite. A little brook of cold water flows close to the spring and partly mixes with it.

Maximum temperature, 55° C. (131° F.).

Analysis of a sample of the water after simple filtration to remove suspended matter :—

Total solids dissolved in water, 22.5 grains per gallon.

Hardness,	4		
Chloride,	0.7	,,	,,
Free Ammonia,	0.04	parts per	million.
Albuminoid Ammonia,	0.06	,,	,,

Constituents dissolved in 10,000 parts of the water :—

Calcium Carbonate,	0.250	parts in	10,000.
Calcium Sulphate,	0.270	,,	,,
Magnesium ,,	0.015	,,	,,
Sodium ,,	0.185	,,	,,
Potassium,	0.095	,,	,,
Sodium Carbonate,	0.320	,,	,,
Ammonium Carbonate,	0.000180	,,	,,
Sodium Chloride,	0.100	,,	,,
Potassium ,,	0.090	,,	,,
Lithium, ,,	trace	,,	,,
Boric Acid,	... ...	,,	,,
Sodium Sulphide,	0.025	,,	,,

Iron, Alumina and Manganese,	0.125	parts in	10,000.
Hydrogen Sulphide, ...	0.019	,,	,,
Carbonic Acid, ...	0.450	,,	,,
Nitrogen, ...	0.089	,,	,,
Silica, ...	0.595	,,	,,
Organic Matter, ...	0.195	,,	,,
	2.82318	parts in	10,000

Composition of Gases escaping from the Springs.

A number of analyses were made of the gases which are given off by these hot springs, and they were found to consist principally of Nitrogen and Carbonic Acid with small quantities of Hydrogen Sulphide and Marsh Gas.

THERAPEUTIC VALUE OF THE SPRINGS.

In my remarks upon the general nature of the springs, I have already pointed out that they must be classed with simple thermal waters, as they contain but an insignificant amount of solid matter excepting Silica which has but little physiological action. All the springs, however, contain Hydrogen Sulphide, and although the quantity present is sufficient to warrant their being classed with "Sulphurous Waters" in the strict sense of the word, yet it suffices to impart to them a distinct therapeutic value. In addition to this, their temperature is an important item, considered medicinally. There are a number of well-known springs in Europe, which owe their virtues apparently to their temperature only and contain as little or less mineral matter than the Selangor springs and less Hydrogen Sulphide or none at all (Matlock; Buxton; Wildbad; Aix en Provence).

Among the Selangor springs Ulu Klang ranks first as possessing the highest temperature and containing most Hydrogen Sulphide. The remainder may be placed in order of merit thus:—Setapak; Dusun Tua; Semunieh; Gombah. Ulu Selangor would probably be the last in the list, although I cannot say so definitely, as I did not personally inspect and examine this spring. In any case it would come after Setapak

On reference to the data of analysis of the Ulu Klang and Setapak waters, it will be seen that they contain the following amounts of Hydrogen Sulphide dissolved in every 10,000 parts of the water :—

Ulu Klang, ...	... 0.035	(Temp. 151° F.).
Setapak, ...	... 0.034	(„ 122° F.).

Now the average amount of Hydrogen Sulphide in *cold* sulphurous springs may be taken as 0.090 parts in 10,000; hence the Ulu Klang and Setapak contain a very fair fraction of this amount and possess a high temperature at the same time. Both of them may, therefore, be recommended for bathing or drinking purposes. Their action would be stimulating and diaphoretic, and they would be found valuable in :—Chronic Skin Diseases and Rheumatism; Chlorosis; Amenorrhœa; Secondary Syphilis; Dyspepsia due to disordered action of the liver. I do not think it practicable to bottle and sell the water, as this would result in the loss of almost all its volatile and valuable constituents by evaporation and subsequent decomposition. The water should be used on the spot and as nearly at the temperature of the spring as may be found endurable.

The suggestions arising from the above are :—

I.—That the hot springs in Selangor, more particularly those at Ulu Klang and Setapak, are by virtue of their temperature and chemical composition therapeutically valuable.

II.—The springs at Ulu Klang and Setapak should be properly set and made available for bathing and drinking purposes. It is almost needless to say that every care should be taken to prevent any communication between the water used for bathing and drinking purposes respectively.

It should be mentioned here that the Malays and Chinese seem to be well aware of the virtues of these springs, and particularly of their specific action in skin diseases. They bathe in them freely, and I am informed that the Chinese more or less monopolise some springs, the Malays others. As far as I could learn they never drink the water.

Ultimate Origin of the Springs.

The geology of the springs is a subject of great interest, but unfortunately one not to be approached or settled in an easy, off-hand manner. Much patient study of actual sections in the immediate vicinity of the springs, examination of deeper strata by boring, in short a complete geological survey alone, can throw light upon this question. One is accustomed to associate hot springs with volcanic action, yet these springs occur in parts far distant from any known volcanic belt.

No basalt and no minerals indicative of direct volcanic action are to be found in the neighbourhood. The composition of the water is, in some respects, similar to the water ejected by the geysers of Iceland, but here the analogy ends. Beyond conjectures pure and simple, I can at present pronounce no opinion as to the final source of these springs, viz., the question of direct volcanic action or simple intra-terrestial heat. I sincerely hope, however, to have an opportunity to follow up this subject later on.

In conclusion, I wish to refer to a paper by Mons. STANISLAS MEUNIER published in J. cx, p. 1085 of the Compt. Rend. 'Examen chimique d'eaux minérales provenant de Malairé. Mineral d'etain de formation actuelle.' The paper describes the analysis of two bottles of water brought by Mons. J. ERRINGTON DE LA CROIX from Ayer Panas and Cheras, and contains the following statements among others :—

1.—The water had a bad smell on opening bottle.

2.—On heating it gave off gas bubbles.

3.—On evaporation it left a syrupy residue which was incinerated and gave two milligrams of ash per 100 cc. water taken.

4.—Exposed to the air for a few hours the water fills itself with white, viscous vegetations not botanically determined.

5.—The Ayer Panas water had no taste ; the Cheras water no smell, but a slightly saline taste, and on heating gave off myriads of gas, probably pure Nitrogen amounting to 10 cc. per litre.

6.—The water contained Chlorine, but no Sulphates, and about 1.4 grams Sodium Chloride per litre.

7.—A mineral found in the spring is described, having a spec. gravity 2.1, cavernous and tuberculous structure, whitish grey colour with small black dendritic particles in it. The composition of this is given as :—

Silica,	91.8 %
Water,	7·5 ,,
Tin Oxide,	0·5 ,,
Iron,	0.2 ,,
Aluminium,	traces
	100.0 ,,

From this the author draws the remarkable conclusion that this substance is a kind of opal similar to geyserite, but containing tin as a peculiar and characteristic constituent.

He goes on to say that this is the first time that tin has been found in *statu nascenti* as it were, viz., in the act of deposition from its mother liquor, and looks upon this as an important contribution to the theory of the formatiom of tin ore.

It needs but a glance at the statements above cited to show that they are of no value at all, in fact mostly absurd, but I append a few remarks upon these points, lest a casual reader of the paper should be deceived by them and attach credit to the grand but unfortunately erroneous deduction (No. 7) in which that paper culminates. It seems strange that matter so devoid of point and substance should have found its way into the Compt. Rend. :—

1. *Bad Smell.*—Most waters would have a bad smell after being carried from Selangor to France.
2. *Bubbles on heating.*—All water, unless specially treated, gives off bubbles on heating.
3. *Syrupy Residue on evaporation.*—The water leaves a *solid* residue. The ash is more than 4 milligrams per 100 cc.
4. *White, viscous vegetations.*—These are probably the

siliceous deposits mentioned in my paper. They do not form in a few hours as stated, and the water does not *fill itself* with them.

6. *No Sulphates, but about 1.4 grams Sodium Chloride per litre.*—The water naturally contains Sulphates, and the Chloride amounts to 0.015 grams at most.
7. The description given is that of common sinter met with in all hot springs, almost without exception. As for the tin in it, it would be difficult in these parts to pick up a mineral which did *not* contain a trace of tin, as is well enough known. There is absolutely nothing remarkable in the presence of tin in this sinter, the very granite upon which it grows carries traces of tin. The bold theory of *tin oxide* being deposited from water containing *Sulphuretted Hydrogen* is not compatible with chemical laws, is a chemical impossibility.

I desire to add that I have appended the above remarks purely by way of correcting erroneous statements, and nothing is further from my thoughts than "sitting on" the author of them. It must be borne in mind that he could only work with a small sample sent to him in France, and which probably arrived in a more or less altered condition. He never saw the springs nor the water fresh from them.

W. BOTT.